FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION – 2025
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

APPLIED MATHEMATICS

TIME ALLOWED: THREE HOURS **PART-I(MCQS): MAXIMUM 30 MINUTES**	**PART-I (MCQS) MAXIMUM MARKS = 20** **PART-II MAXIMUM MARKS = 80**
NOTE: **(i)** First attempted **Part-I (MCQS)** on the separate **OMR Answer Book** which shall be taken back after 30 minutes**.** **(ii) Overwriting/cutting** of the **options/answers** will not be given credit. **(iii)** There is no **negative marking**. All **MCQs** must be attempted.	

Q. No. 1 (a) Prove that $\nabla \cdot (r^n \vec{r}) = (n+3)r^n$, where $\vec{r} = xi + yj + zk$. **(10)**

(b) If $\vec{a} \cdot (\vec{b} \times \vec{c}) = (\vec{a} \times \vec{b}) \cdot \vec{c}$, then prove that $\vec{a}$ and $\vec{c}$ are parallel.

Find the area of the region that is enclosed between the curves $y = x^2$ and $y = x + 6$. **(10)**

Q. No. 2 (a) Find the tangential and normal components of acceleration of a point describing the ellipse $x^2/a^2 + y^2/b^2 = 1$ with uniform speed $\vec{V}$, when the particle is at (0, b). **(10)**

(b) Find the solution of initial value problem by separation of variables:
$\sqrt{(1-y^2)}\, dx - \sqrt{(1-x^2)}\, dy = 0$ (10)

Q. No. 3 (a) Find the general solution of the given differential equation by variation of parameters: **(10)**
$3y'' - 6y' + 6y = e^x$ (10)

(b) Find the power series solution of $(x+1)y'' + xy' - y = 0$. **(10)**

Q. No. 4 (a) Forces 2BC, CA, AB act along the sides of a triangle ABC. Show that their resultant is 0. Where D bisects BC and E is a point on CE such that CE = 1/3 CA.
(10)

(b) Find the center of mass of the surface generated by the revolution of the arc of the parabola,

lying between the vertex and the latus rectum, about the x-axis.
(10)

Q. No. 5 (a) Obtain the Fourier series over the indicated interval for the given function:

$f(x) = 3\pi + 2x,\ -\pi < x < 0;\ = 2x,\ 0 < x < \pi$ **(10)**

(b) Solve the boundary value problem:

$$u_{xx} + u_{\gamma\gamma} = 0,\ 0 < x < a,\ 0 < y < b$$
$$u(x,0) = 0,\ u(a,y) = 0,\ 0 \le y \le b$$
$$u(0,y) = 0,\ u(x,b) = f(x),\ 0 \le x \le a$$
(10)

Q. No. 6 (a) Use Newton's Raphson method to find the solution accurate to within 10^{-4} (corrected up to four decimal places) for the given problem: **(10)**

$x - \cos x = 0,\ [0, \pi/2]$

(b) Solve the system of linear equations using Gauss Seidel method (with three digit rounding arithmetic):

$$3x_1 + 4x_2 - x_3 = 8$$
$$5x_1 + 2x_2 + 2x_3 = 3$$
$$-x_1 + x_2 - 3x_3 = -8$$
(10)

Q. No. 7 (a) Use Euler's method to approximate the solution of the initial value problem. **(10)**

$y' = 1 + y / x,\quad 1 \le x \le 2,\ y(1) = 2,\ \text{with } h = 0.25$

(b) Using Green's theorem, evaluate $\oint F(r) \cdot dr$ counter clock wise around the boundary curve C of the region R, where $F = [1/2 \cdot xy^4,\ 1/2 \cdot x^2 \cdot y]$, the rectangle with vertices (0, 0), (3, 0), (3, 2), (0, 2). **(10)**

Q. No. 8 (a) Evaluate the Integral $\int_1^3 (1 / x^2)\, dx$. Using Trapezoidal Rule for five points (corrected upto two decimal places). **(10)**

(b) Find the D'Alembert solution of the wave equation $u_{xx} = (1 / c^2) \cdot u_{tt}$ subject to the Cauchy Initial conditions $u(x, 0) = f(x),\ u_t(x, 0) = g(x)$. **(10)**